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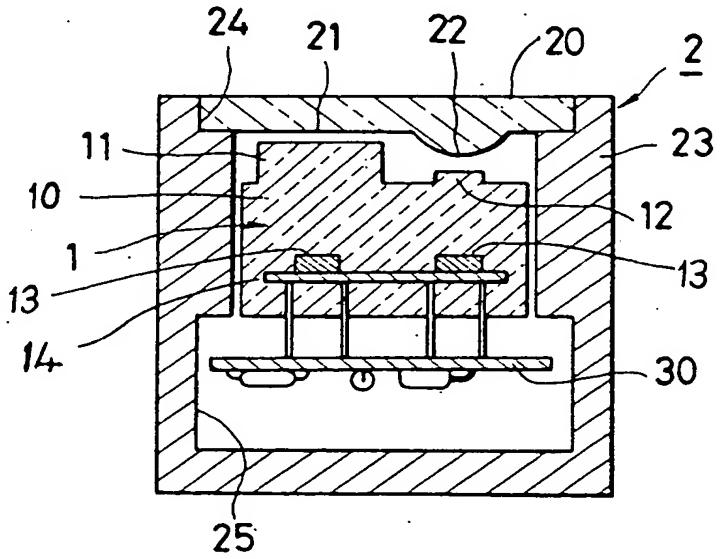
# (54) Composite light sensor

(57) A composite light sensor comprises a sensor portion (1) and a case portion (2). The sensor portion is composed of a plurality of light detecting elements (13) mounted on a substrate (14) and encapsulated in a body (10) of light-transmitting resin which has a forward face formed with light receiving portions (11, 12) corresponding to respective light detecting elements. The case portion comprises a holder (23) accommodating the sensor portion and fitted with a front lens (20) formed with lens portions (21 and 22) corresponding to the respective light receiving elements (11 and 12) fo the sensor portion. The combination of sensor portion and case portion provides different optical characteristics, such as viewing angles, for each detector.

FIG.6

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SPECIFICATION

## Composite light sensor

This present invention relates to a composite light sensor comprising a plurality of light detecting elements which are integrally mounted for measuring respective different illumination criteria, for example for measuring circumferential illumination and forward illumination in a system for automatically energising the headlamps of an automobile.

Hitherto, a plurality of separate light sensors have been required when measuring different illumination criteria, such as an average illumination criterion and a partial illumination criterion.

Such conventional sensor arrangements, however, present problems, in that it is firstly difficult to make the arrangement small in size because a plurality of independently mounted light sensors are involved, and it is secondly necessary to adjust the mounting direction of the individual light sensors thereby rendering the manufacturing process complex.

The present invention aims to solve the above-mentioned problems of the conventional light sensor arrangements and, to this end, the invention provides a composite light sensor comprising a sensor portion housed in a case portion, in which composite sensor the sensor portion comprises at least two light detecting elements encapsulated in a light-transmitting body having a forward face formed with respective light receiving portions through which light passes to the light detecting elements, the case portion includes light receiving means for transmitting light to the sensor portion, and the light receiving means of the case portion is formed so that the light detecting elements are provided with respective different optical characteristics, such as different light receiving angles.

In order that the invention may be readily understood, embodiments thereof will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view showing one embodiment of a sensor portion of a composite light sensor according to the present invention;

Figure 2 is a front view of the light sensor portion of Figure 1;

Figure 3 is a sectional view showing the light sensor portion of another embodiment of the present invention;

Figure 4 is a sectional view showing the light sensor portion of a further embodiment of the present invention;

Figure 5 is a front view of the light sensor portion shown in Figure 4;

Figure 6 is a sectional view showing a sensor portion and a case portion of a composite light sensor assembled together; and

Figure 7 is an enlarged view showing in detail an assembled sensor portion and case portion of a modified composite light sensor.

Referring to the accompanying drawings, Figures 1 and 2 show one form of a sensor portion 1 of a composite light sensor embodying the present invention. The sensor portion 1 has two light detecting elements 13, such as photodiodes, integrally moulded into a light transmitting body 10 of epoxy resin or the like to form a moulded package. A forward surface of the body in front of the light detecting elements 13 is formed with two respective light receiving portions 11 and 12 shaped to provide respective suitable optical characteristics such as a desired light receiving angle, required for each of the light detecting elements 13.

The light detecting elements 13 are mounted at a respective predetermined positions on a ceramic substrate 14 and connected to lead wires 15 prior to encapsulation in body 10, so that they are easily fabricated. It is also possible to incorporate an amplifying circuit for the light detecting elements 13 into the ceramic substrate 14, as indicated by numeral 16 in Figure 1 by way of example.

Another embodiment of a sensor portion 1a of a composite light sensor in accordance with the present invention is shown in figure 3. In this embodiment, the light receiving portion 12a of the moulded body 10a takes a spherical form. As exemplified by this embodiment, the light receiving portion may be made to any shape suitable for the desired light measurement to be effected. Apart from the light receiving portion 12a, the rest of Figure 3 embodiment is the same as the embodiment of Figures 1 and 2 and further explanation thereof is therfore omitted. No amplifying circuit 16 is however indicated in Figure 3.

A further exemplary sensor portion Ib of a light sensor embodying the present invention is illustrated in Figures 4 and 5. As shown in Figures 4 and 5, moulded body 10b of the sensor portion 1b has a plane forward face formed with a slit-like recess 17 of suitable width in a central position between a light receiving portion 11b and a light receiving portion 12b of the moulded body 10b encapsulating the light detecting elements 13. Opaque material 18 is received in the slit-like recess 17 to form a shading portion to prevent the light incident on one light receiving portion 11b or 12b reaching the other light detecting element 13 corresponding to the other light receiving portion 12b or 11b. Furthermore, external light is hardly incident on the lower portion of the slit-like recess 17, so that it is preferable to install a semi-conductor integratedcircuit chip 19 used as an amplifier for the light detecting elements 13 on substrate 14 in the shadow beneath the recess 18 as shown in Figure 4, thereby avoiding any malfunctioning of the amplifier due to the external light.

Figure 6 shows a case portion 2 within

which the sensor portion 1 of Figure 1 is mounted to constitute a composite light sensor embodying the invention. The sensor portion 1 may, of course, be replaced by the sensor portion 1a or 1b shown in Figure 3 or 4 respectively. The case portion 2 is composed of a front lens structure 20 made of a light-transmitting resin and forming a closure for a holder 23 made of a non-light-transmitting resin. The front lens structure 20 has light receiving lenses 21 and 22 constituting light receiving means corresponding respectively to the light receiving portions 11 and 12 of the sensor portion 1. In this embodiment, one lens 21 has a flat shape in order to provide a wide light receiving angle and the other lens 22 has a convex shape in order to narrow the light receiving angle. Thus, the shape of the light receiving lens may be made in accordance with the desired light measurement criterion. It is possible to incorporate in the front lens structure 20 a slit-like shading portion of the kind shown in the embodiment of Figures 4 and 5. Within the holder 23 there are provided mounting portion 24 for receiving the front lens 20 and a circuit housing portion 25 for accommodating a drive circuit 30 for the sensor portion 1.

A main portion of a modified composite type light sensor embodying the present invention is illustrated on an enlarged scale in Figure 7. In particular, Figure 7 shows a shading recess 27a provided on the front lens 20 and filled with a non-light-transmission material 28. Furthermore, a slit-like recess 17a is formed in the forward face of the sensor portion 1 and a projecting portion 27b of the lens structure 20 at the back of the recess 27a is fitted into the recess 17a to serve as a locating member for correctly positioning the light receiving lenses 21 and 22 relative to the respective light receiving portions 11 and 12 when the sensor portion 1 is received in the case portion 2. By this arrangement, a high precision in the fabrication of the assembly is easily maintained and assembly errors are prevented.

In the composite sensor described above with reference to Figure 7 the light receiving portion 11 is made wide with respect to the light detecting element 13a and the light receiving lens 21 is made in a flat shape, so that an optical characteristic with a light receiving angle $\alpha$ of about 45° is obtained. On the other hand, the light receiving portion 12 is made narrow with respect to the light detecting element 13b and the light receiving lens 22 is characteristic with a light receiving angle $\beta$ of about 35° is obtained. Thus, two different measuring objectives are achieved, namely sensing of a wide angular light field by element 13a and sensing of a narrow angular light field by element 13b.

As mentioned above, a composite light sensor embodying the present invention comprises the sensor portion having at least two light detecting elements encapsulated in the light-transmission resin body which has a forward surface formed as a light receiving portion, the light receiving means of the case portion being formed so as to provide different optical characteristics such as light receiving angle through the light receiving portion of the sensor portion with respect to the respective light detecting elements. Therefore, it is possible to provide a single sensor to detect the illumination from different directions, such as wide angle ranges and narrow angle ranges to the front and in inclined directions, to minimize the number of parts and thereby make the sensor compact, to shade an integrted circuit amplifier from the incident light and thereby increase the reliability of the sensor, and to facilitate the relative positioning of the parts.

## CLAIMS

1. A composite light sensor comprising a sensor portion housed in a case portion, in which composite sensor the sensor portion comprises at least two light detecting elements encapsulated in a light-transmitting body having a forward face formed with respective light receiving portions through which light passes to the light detecting elements, the case portion includes light receiving means for transmitting light to the sensor portion, and the light receiving means of the case portion is formed so that the light detecting elements are provided with respective different optical characteristics, such as different light receiving angles.

2. A composite light sensor according to claim 1, wherein a light receiving portion corresponding ta at least one of the light receiving elements has a spherical shape.QL 3. A composite light sensor according to claim 1 or 2, wherein a slit-like recess is formed in the forward face of the light-transmitting body of the sensor portion or in the light receiving means of the case portion, and non- light-transmission material is received in the slit-like recess to form a shading portion.

4. A composite light sensor according to claim 3, wherein a semi-conductor integrated circuit chip is disposed in the shadow of the shading portion.

5. A composite light sensor according to any one of claims 1 to 4, wherein a projecting portion on the rear surface of the light receiving means of the case portion serves as a locating member for determining the relative positions of the light receiving means of the case portion and the light detecting elements of the sensor portion in the assembled sensor.

6. A composite light sensor substantially as hereinbefore described with reference to the accompanying drawings.

7. Any novel feature or combination of fea-

tures described herein.

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FIG.1

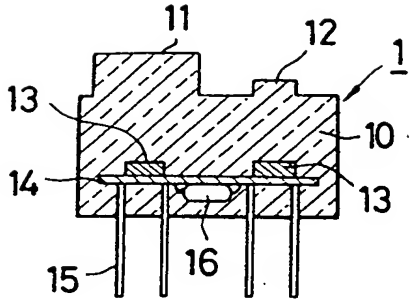


FIG.2

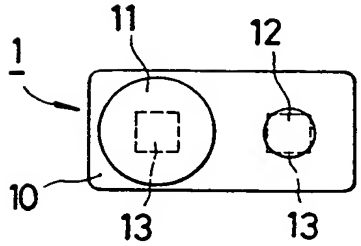


FIG.3

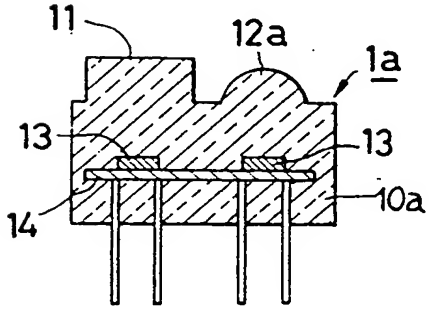


FIG.4

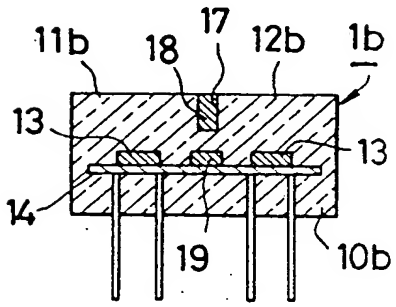


FIG.5

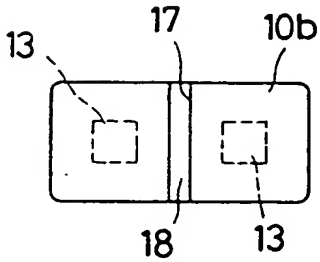

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FIG.6

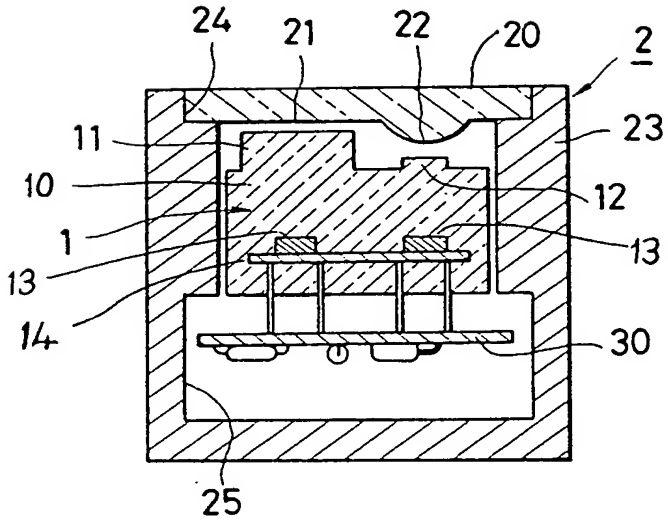


FIG.7